1. An apparatus for coherent wavelength-shift multiplexing, the apparatus comprising:

a photonic input path configured to carry a photonic input signal having a base wavelength definable as a function of time;

a photonic output path configured to carry a multiplexed photonic signal comprising a reference channel and a data channel, the reference channel and the data channel each having a wavelength pattern uniquely corresponding thereto;

a splitter configured to split the photonic input signal into first and second daughter signals;

a data signal;

a modulation synthesizer configured to provide a first modulation waveform configured to shift the base wavelength to substantially match the wavelength pattern of the reference channel, provide a second modulation waveform configured to shift the base wavelength to substantially match the wavelength pattern of the data channel, and pre-modulate the second modulation waveform to encode the data signal into the data channel signal;

first and second modulation devices configured to modulate the first and second daughter signals in accordance with the first and second modulation waveforms, respectively, to provide a photonic reference signal corresponding to the reference channel and a photonic data signal corresponding to the data channel; and

a combiner configured to combine the photonic reference signal and the photonic data signal to provide the multiplexed photonic signal.

2. The apparatus of claim 1, further comprising:

a wavelength error detector configured to detect wavelength pattern errors in the multiplexed photonic signal and provide a wavelength error signal; and

the modulation synthesizer further configured to adjust the modulation waveforms in proportion to the wavelength error signal, thereby correcting the wavelength pattern errors.

3. The apparatus of claim 2, wherein the wavelength error detector is configured to detect wavelength pattern errors in the reference channel.

4. The apparatus of claim 1, wherein the modulation synthesizer is configured to encode the data signal by a step selected from the group consisting of phase-shift keying, amplitude-shift keying, and pre-modulating with orthogonal codes.

5. The apparatus of claim 1, further comprising:

a shift input line configured to carry a shift signal; and

the modulation synthesizer further configured to provide a modulation waveform configured to shift the base wavelength in proportion to the shift signal.

6. The apparatus of claim 5, wherein the shift signal is characterized by a function selected from the group consisting of a spreading function, a gathering function, a difference of two spreading functions, and a range of allowable wavelength shifts.

7. The apparatus of claim 1, wherein the modulation device is selected from the group consisting of a phase modulator and a quadrature amplitude modulator.

8. The apparatus of claim 7, wherein the quadrature amplitude modulator comprises an upper branch and a lower branch, each having a transfer function corresponding thereto, the modulation waveform being a quadrature waveform comprised of upper and lower waveform components corresponding to the upper and the lower branch, respectively, the upper and lower waveform components being substantially 90 degrees out of phase.

9. The apparatus of claim 8, wherein the upper and lower waveform components each have a value that is substantially that of a sinusoid divided by the respective transfer function corresponding to the respective upper and lower branch.

10. The apparatus of claim 8, wherein the upper and lower waveform components are selected from the group consisting of a substantially sawtooth shape and a substantially triangular shape.

11. The apparatus of claim 1, wherein the modulation waveform is selected from the group consisting of a substantially sawtooth shape and a substantially triangular shape.

12. A method for coherent wavelength-shift multiplexing comprising:

providing a photonic input signal having a base wavelength definable as a function of time;

splitting the photonic input signal into first and second daughter signals;

providing a data signal;

providing a first modulation waveform configured to shift the base wavelength to substantially match a wavelength pattern of a reference channel;

providing a second modulation waveform configured to shift the base wavelength to substantially match a wavelength pattern of a data channel;

encoding the data signal by pre-modulating the second modulation waveform;

modulating the first and second daughter signals in accordance with the first and second modulation waveforms, respectively, to provide a photonic reference signal corresponding to the reference channel and a photonic data signal corresponding to the data channel; and

combining the photonic reference signal and the photonic data signal to provide a multiplexed photonic signal.

13. The method of claim 12, further comprising:

detecting wavelength pattern errors in the multiplexed photonic signal; and

adjusting the first and second modulation waveforms to correct the wavelength pattern errors.

14. The method claim 13, wherein detecting comprises detecting wavelength pattern errors in the reference channel.

15. The method of claim 12, wherein the data signal is encoded by a technique selected from the group consisting of phase-shift keying, amplitude-shift keying, and pre-modulating with orthogonal codes.

16. The method of claim 12, further comprising:

providing a shift signal; and

providing a modulation waveform configured to shift the base wavelength in proportion to the shift signal.

17. The method of claim 16, wherein the shift signal is characterized by a function selected from the group consisting of a spreading function, a gathering function, and a difference of two spreading functions.

18. The method of claim 12, wherein modulating is selected from the group consisting of phase modulation, quadrature amplitude modulation, and modulating by providing the second modulation waveform as a quadrature waveform comprising first and second waveform components that are substantially 90 degrees out of phase.

19. The method of claim 18, wherein at least one of the first and second waveform components each have a value selected from the group consisting of a sinusoid divided by a transfer function corresponding to a modulation device, a substantially sawtooth shape, and a substantially triangular shape.

20. An apparatus for coherent wavelength shift demultiplexing comprising:

a photonic input path configured to carry a multiplexed photonic signal comprising a reference channel and a data channel, the reference channel and the data channel each having a wavelength pattern uniquely corresponding thereto;

a splitter configured to split the multiplexed photonic signal into a photonic input signal and a photonic reference signal;

a modulation synthesizer configured to provide a modulation waveform effective to change the wavelength pattern of the data channel to the wavelength pattern of the reference channel;

a modulation device configured to modulate the photonic input signal with the modulation waveform to provide a photonic output signal; and

a coherence detector configured to compare the photonic output signal with the photonic reference signal, thereby extracting a data signal.